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A new species of snake of the genus *Oligodon* Boie in Fitzinger, 1826 (Reptilia, Serpentes) from the Western Himalayas

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Abstract

A new species of *Oligodon* Fitzinger, 1826 is described based on specimens collected from Churah Valley of Himachal Pradesh. The new species is related to *O. arnensis* based on molecular as well as morphological data, however differs from it in several aspects. The new species shows a pairwise sequence divergence of 6–20% from congeners for mitochondrial cytochrome b gene. Lack of pterygoid and palatine teeth of the new species suggests that the diet may largely comprise of eggs. Discovery of the new species is not surprising, as the Western Himalayas has been poorly explored in terms of its herpetofaunal diversity. Considerable genetic divergence in the sampled sequence suggests *Oligodon arnensis* is a species complex, likely represents multiple species and a revision of the group would be desirable.

Key Words

Colubridae, cytochrome b, Himachal Pradesh, Kukri snake, taxonomy

Introduction

The colubrid snake genus *Oligodon* Boie in Fitzinger, 1826 is represented by 84 species distributed throughout Asia (Uetz and Hallermann 2021) and the number of species within the genus has increased considerably in the recent past. This is a result of description of several new species largely due to an integrated taxonomic approach (Nguyen et al. 2020). The high diversity with morphologically cryptic species and secretive behavior of members of the genus makes species delimitation a daunting task (Smith 1943; Whitaker and Captain 2004; Tillack and Günther 2009; Nguyen et al. 2020). Furthermore, lack of molecular data for all known species, especially from type localities of the relevant taxa makes compilation of revisionary work difficult, more so for cryptic species. Lastly, poor representation of specimens in natural history museums adds another layer of difficulty (David et al. 2011).

The Himalayas is one of the global biodiversity hotspots known for its high degree of endemism (Myers et al. 2000). The Eastern Himalayas are said to be more biodiverse in comparison with that of the Western Himalayas. The topography, climate and forest type indeed play a major role in the Eastern Himalayas being more biodiverse, however, this may also be attributed to an extent to lack of dedicated surveys conducted in the Western Himalayas for herpetofaunal documentation (Mirza et al. 2020a). Most surveys conducted across the region have largely employed morphology-based species identification methods for estimating herpetofaunal species

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diversity leading to underestimation of the region's biodiversity (pers. obs.).

As part of an ongoing study on the reptiles of Himachal Pradesh, we collected specimens of a species of the genus *Oligodon* that resembled *O. arnensis* (Shaw, 1802) based on general appearance and dorsal scales round the body. *Oligodon arnensis* was described based on Russell's (1796) plate XXXVIII (Fig. 1b). Later, Daudin (1803) described *Coluber russelius* based on Russell's (1796) plate XXXV of a specimen from Visakhapatnam, Andhra Pradesh (Fig. 1a), plate XXXVIII of a specimen from Arni, Tamil Nadu (Fig. 1b) and plate LXXVI of Daudin (1803). Günther (1864) described another species *Simotes albiventer* from Sri Lanka (Ceylon) and Hodgson (Cantor 1839) described *Coluber monticolus* from Nepal. Boulenger (1890) listed *Coluber russelius*, *Simotes albiventer* and *Coluber monticolus* in the synonymy of *Oligodon arnensis*. Recently, Tillack et al. (2021) assessed the validity of *Coluber monticolus* and showed that is synonymous with *Boiga multifasciata* (Blyth 1861) and removed it from the synonymy of *Oligodon arnensis*. This action rendered *O. arnensis* only putative synonyms, *viz Coluber russelius* bearing a loreal shield and *Simotes albiventer* that lack a loreal shield. Comparisons of the population from Himachal Pradesh were made with the original description and the iconotype (see Discussion) and topotypic material. The specimens from Himachal Pradesh differed in several aspects of their morphology as well were found to be genetically divergent from populations of *O. arnensis* from peninsular India and Sri Lanka. The specimens from Himachal Pradesh are here found to be a distinct species from *O. arnensis* and is herein described as a new species.

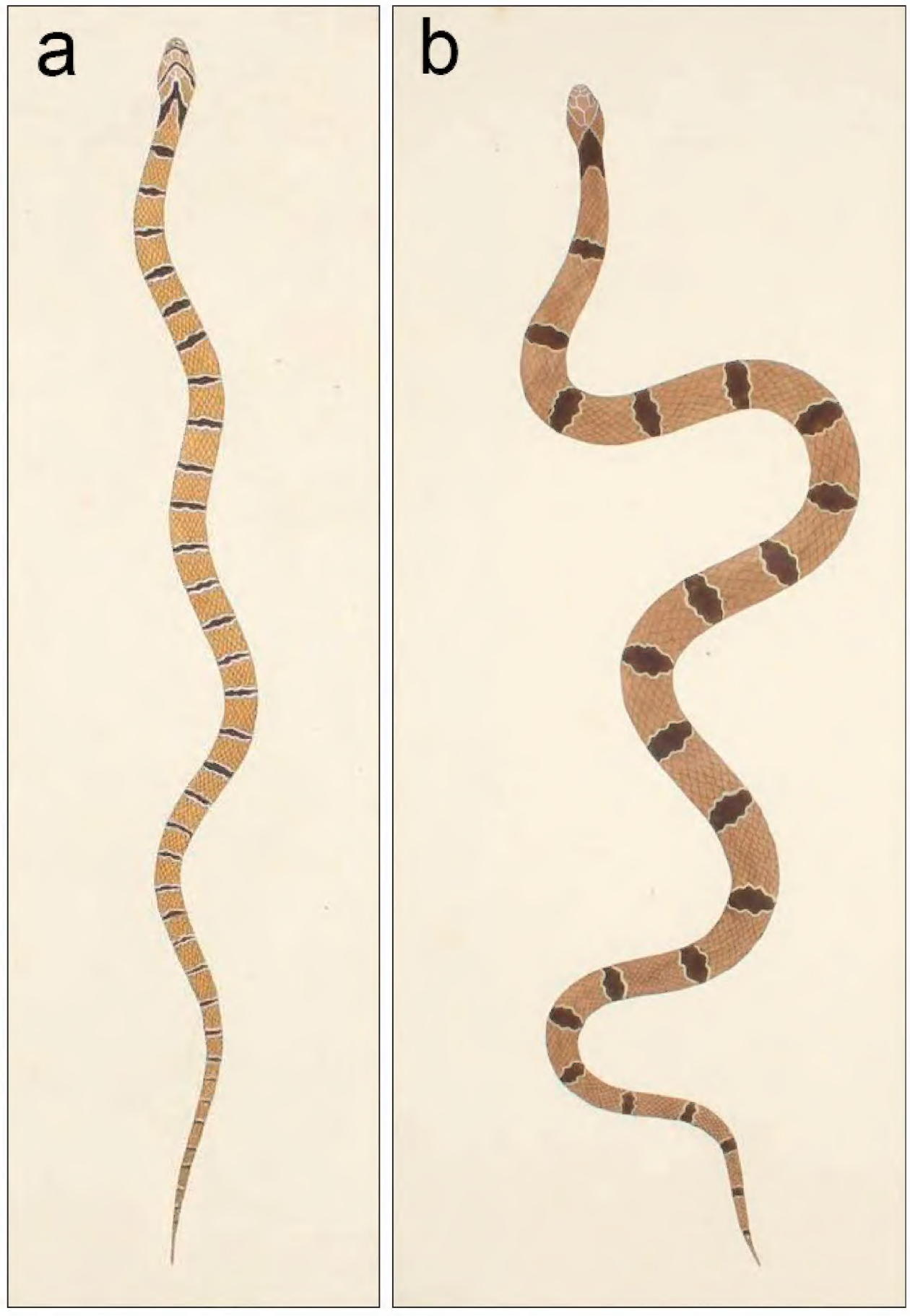

Figure 1. Plate XXXV (**a**) of *Coluber russelius* and XXXVIII (**b**) of *Simotes arnensis* from Russell (1796). Plate XXXVIII (b) is the iconotype for the species. See Suppl. maetrials 1, 2 for unedited illustrations.

Materials and methods

Morphology

The study was conducted under the permit number WLM/2603 issued by the Forest Department of Himachal Pradesh, Government of India. Two specimens were captured by hand and euthanized with Halothane as per the directive outlined by standard euthanasia protocols (Leary et al. 2013). The specimens were fixed in 4% formalin and later stored in 70% ethanol. The specimens are deposited in the Research Collection Facility of the National Centre for Biological Sciences (NCBS), Bangalore and the collection of the Bombay Natural History Society, Mumbai. Measurements were taken with digital calipers to the nearest 0.1 mm and total length was measured using a non-elastic thread with an error of 5 mm.

Morphological data for related species were compared with relevant literature (Smith 1943; Whitaker and Captain 2004; Vijayakumar and David 2006; Ganesh et al. 2009) and material examined from natural history museums listed below. Ventral scales were counted following Dowling (1951b). The number of dorsal scale rows was counted at approximately one head length behind the head (at 10th ventral), at midbody, and at about one head length before the vent (10th ventral before the cloacal plate), respectively. The dorsal scale reduction formula follows Dowling (1951a) with modifications as proposed by Das et al. (2010) and Mirza et al. (2016). Subcaudal counts reported here do not include the terminal scale. Dorsal band count excludes the chevron bands on the head and the nape. The style of description follows Mirza et al. (2016) with some modifications. Abbreviations used to describe scalation and other comparable characters are: V, ventrals; PrV, preventrals; SC, subcaudals; DSR, dorsal scale rows; SVL, snout-vent length; TaL, tail length; TL, total length. Images were taken with the help of a Canon 700D camera using a Canon 100-mm macro lens and illumination using two Canon 430exII Speedlite flashes. MicroCT scans were generated following protocols outlined in Mirza et al. (2020b) as described below. Scans were generated for the holotype of the new species and a specimen of *O. arnensis* from Savandurga, Karnataka (NCBS NRC-AA-020). Micro-CT scan were generated for the male specimen using a Bruker® Skyscan 1272 (Bruker BioSpin Corporation, Billerica, Massachusetts, USA). Head of the specimen was scanned for 210 minutes at resolution of 3 µm and recording data for every 0.4° rotation for 360° with (AL) 1 mm filter. The source voltage for the scan was 65 kV and source current was 153 uA. Volume rendering was performed with CTVox (Bruker BioSpin Corporation, Billerica, Massachusetts, USA) and images were edited in Adobe Photoshop CS6. Osteological description is based on volume renders retrieved from CTVox and nomenclature of features and terminologies follow Cundall and Irish (2008).

The hemipenis of freshly euthanized male paratype were everted by palpation of the organ until it was everted to the maximum extent, after which the organ was separated by making an incision around its circumference at the cloacal region and was immersed in warm water (50 °C) for about 5 minutes to soften the tissue. Then, it was slowly everted using a blunt forceps by gently pushing the organ from the distal to proximal end. After eversion, the organ was inflated with 4% formaldehyde and tied at the base with a thread. Later it was stained in 1% alizarin red solution for one hour. Observations were made using a Leica S8APO stereomicroscope. Descriptions of hemipenial morphology and terminology follow Smith (1943), Dowling and Savage (1960) and Zaher (1999). The new species is primarily compared to the *Oligodon* species occurring in the Indian subcontinent and especially with members of the clade that the new species belongs to, based on the molecular data. Abbreviations used in the manuscript: Bombay Natural History Society, Mumbai (BNHS); National Centre for Biological Sciences, Bangalore (NCBS); Natural History Museum, London (NHM). LSID for this manuscript is urn:lsid:zoobank.org:pub: CA45E262-22CD-463E-9B8A-13B324319E87

Molecular analysis

Genomic DNA was isolated from the preserved tissues of the type specimens and a specimen of *Oligodon arnensis* from Maharashtra, using Qiagen DNAeasy kits following protocols provided by the manufacturer. A fragment of the mitochondrial cytochrome b (*cyt b*) gene was amplified. Published primers L14919 & H16064 (Burbrink et al. 2000) were used. A 22-µl reaction was set containing 10 µl of Thermo Scientific Dream Taq PCR Master Mix, 9 µl water, 0.5 µl of each primer, and 2 µl template DNA, carried out with an Eppendorf Mastercycler Nexus GSX1. Thermo-cycles used for amplification were as follows: 94 °C for 5 min (denaturation temperature 94 °C for 30 s, annealing temperature 48 °C for 50 s, elongation temperature 72 °C for 1 min) × 30 cycles, 72 °C for 10 min, hold at 4 °C. PCR product was cleaned using a QIAquick PCR Purification Kit and sequenced with an AB 3730 DNA Analyzer. Taxa selected for the molecular phylogenetic analysis followed Zaher et al. (2019). Downloaded sequences were aligned in MegaX (Kumar et al. 2018) using ClustalW (Thompson and Gibson 2002) with default settings. Data were subjected to phylogenetic reconstruction with the TIM2+F+G4, HKY+F+I and TIM+F+G4 model as the sequence substitution model for each of the codon-based partitions respectively, based on the optimal partitioning scheme suggested by ModelFinder (Kalyaanamoorthy et al. 2017) for both ML and GTR+I+G for Bayesian Inference (BI). ML was run for 1000 non-parametric bootstrap replicates with rapid ML search option. BI was implemented in MrBayes 3.2.2 (Ronquist and Huelsenbeck 2003) and was run for 10 million generations and sampled every 1000 generations. A BI run included five parallel chains, three hot and two cold chains. The run was terminated after the standard

deviation of split frequencies of the analysis were < 0.05. Twenty-five percent of trees generated were discarded as burn-in. The tree was visualized and edited in FigTree (Rambaut 2012). The same dataset was subjected to phylogenetic analysis on the IQ-TREE (http://iqtree.cibiv.univie.ac.at) online portal (Minh et al. 2020).

Results

Oligodon churahensis sp. nov.

http://zoobank.org/E7D48769-300F-43B4-8F8B-45E0A8ED414B

Figs 2–6, Table 1

Holotype. female NCBS NRC-AA-019 from near Thanei Kothi village, Churah Valley, Chamba District, Himachal Pradesh, India (32.835467, 76.119381, elevation 1864 m) collected by Virendar Kumar on 22nd June 2020.

Paratype. male BNHS 3657 collected on 25 June 2020, same data as for the holotype.

Etymology. The specific epithet refers to the Churah Valley where the new species was collected.

Suggested common name. Churah Valley Kukri

Diagnosis. A medium sized *Oligodon* (SVL 275 mm) with 17 dorsal scale rows at midbody. Seven supralabials, 3rd and 4th in contact with the eye. Loreal present. 170–175 ventrals, 46–47 subcaudals. Palatine and pterygoid teeth absent. Dorsal patterns consist of 1–2 dorsal scales wide black bands edged with yellow. Ventral scales white with brown smear along the width of each scale, the smear is darker on the lateral edges forming a blotch on each side. 48 to 54 bands in total on the body. Hemipenis forked and spinose throughout.

Comparison. Morphologically *Oligodon churahensis* sp. nov. differs from all South Asian congeners, except *O. affinis* Günther, 1862, *O. arnensis*, *O. cinereus* (Günther, 1864), *O. erythrogaster* Boulenger, 1907, *O. melanozonatus* Wall, 1922, *O. theobaldi* (Günther, 1868), *O. travancoricus* Beddome, 1877, *O. venustus* (Jerdon, 1853) and *O. woodmasoni* (Sclater, 1891), by having 17 dorsal scale rows at midbody. The new species differs from *O. affinis* in having higher (170–175) number of ventral scales (vs. 128–133), higher (46–47) number of subcaudal scales (vs. 23–36) and loreal present (vs. absent) (Smith 1943; Whitaker and Captain 2004). It differs from *O. cinereus* in having higher (46–47) number of subcaudal scales (vs. 29–42), 7 supralabials (vs. 8), hemipenis forked and spinose (vs. hemipenis not forked, lack spines) (Smith 1943). It differs from *O. erythrogaster* by having a loreal present (vs. absent), hemipenis forked and spinose (vs. hemipenis not forked, lack spines) and dorsum with darker bands (vs. dorsum with stripes, bands absent) (Smith 1943). The new species differs from *O. melanozonatus* in having 7 supralabials (vs. 6), higher (46–47) number of subcaudal scales (vs. 42–45) and loreal present (vs. absent) (Smith 1943). It differs from *O. theobaldi* in having 7 supralabials (vs. 8), higher (46–47) number of subcaudal scales (vs. 30–42), hemipenis forked and spinose (vs. hemipenis not forked, lack spines) (Smith 1943). The new species differs from *O. travancoricus* in having higher (170–175) number of ventral scales (vs. 150–155), higher (46–47) number of subcaudal scales (vs. 31–39), loreal present (vs. absent) and hemipenis forked (vs. not forked) (Smith 1943; Ganesh et al. 2009). It differs from *O. venustus* in having higher (170–175) number of ventral scales (vs. 138–165), higher (46–47) number of subcaudal scales (vs. 27–36), loreal present (vs. absent) and hemipenis forked (vs. not forked) (Smith 1943). It differs from *O. woodmasoni* in having 7 supralabials (vs. 6), hemipenis forked and spinose (vs. hemipenis not forked, lack spines) and dorsum with darker bands (vs. dorsum with stripes, bands absent) (Smith 1943; Vijayakumar and David 2006). See Table 3 for a summary of comparison with south Asian species.

The new species is most similar to *O. arnensis* in bearing a banded dorsum, 17 mid-dorsal scale rows and in shape of the Hemipenis. However, differs from *O. arnensis sensu stricto* (see Discussion) in bearing a loreal shield (vs. absent in *O. arnensis*); palatine and pterygoid teeth absent (vs, present in *O. arnensis*, Fig. 4d–f); maxillary teeth gradually increase in size posteriorly (vs. posterior most teeth enlarged abruptly, in *O. arnensis*); ventral scales white with brown smear along the width of each scale, the smear is darker on the lateral edges forming a blotch on each side (vs. ventral scales white, lacking markings in *O. arnensis*); 48 to 54 bands in total on the body (vs. ≤40 in *O. arnensis*).

Description of female holotype NCBS NRC-AA-0019 (Figure 2): The specimen is in good condition preserved in a coil with its head resting outside the coil. The specimen bears a single longitudinal incision (spanning over nine ventral scales) (Fig. 2a, b).

Head short, measuring 10.1 mm from snout to the posterior tip to the parietal scale, comprising 3.6% of total length; high, 5 mm, with steeply domed snout in lateral view; upper jaw visible from ventral side. Head of the same width as the neck (width 6.8 mm). Snout gradually tapering to blunt, rounded tip in dorsal view (Fig. 3a). Rostral subtriangular, slightly visible when viewed from top; wider (2.5 mm) than deep (1.6 mm). Nostrils small, elliptical shaped, present in the posterior border of the anterior nasal. The posterior nasal borders the nostrils. Paired internasals, wider (2 mm) than long (1.1 mm); smaller than prefrontals. Prefrontals, wider (2.5 mm) than long (1.7 mm). Frontal roughly hexagonal, bell shaped, 2.7 mm at the widest anterior border, median length 3.8 mm. Parietals 4.2 mm long, 3.2 mm at its widest anterior border. Temporals 1+2, anterior temporal 2.2 mm long and 0.9 mm wide, posterior upper temporal 2.3 mm long and 0.9 mm wide and the lower posterior temporal 1.6 mm and 1 mm long and wide respectively. Six nuchal scales, slightly larger than adjacent dorsal scales, bordering parietals. Supraocular larger than preocular; preocular large, deeper (2.5 mm) than wide (1.5 mm). Loreal roughly

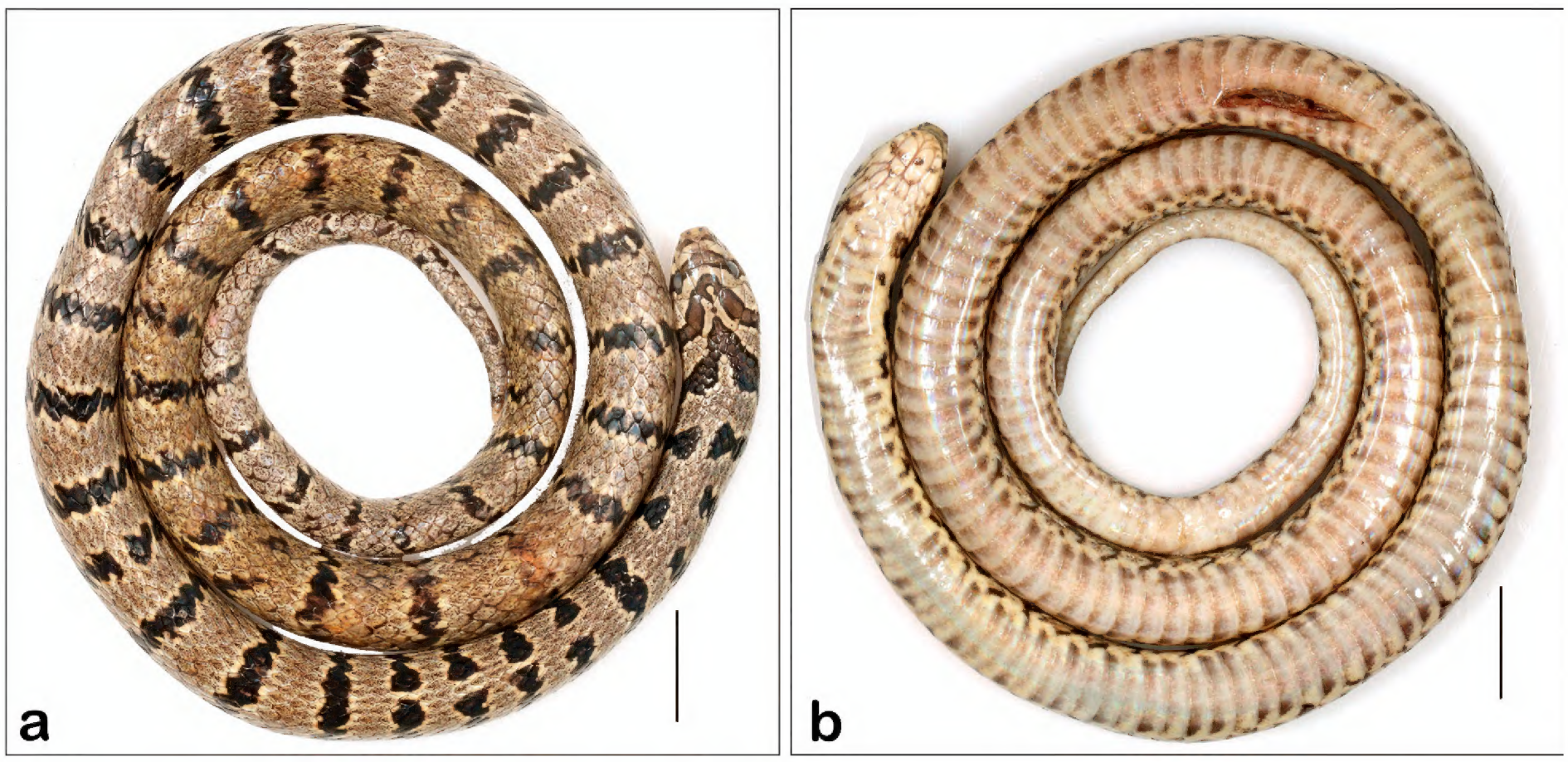

Figure 2. *Oligodon churahensis* sp. nov. holotype female NCBS NRC-AA-019 (**a**) dorsal view, (**b**) ventral view. Scale bars: 10 mm.

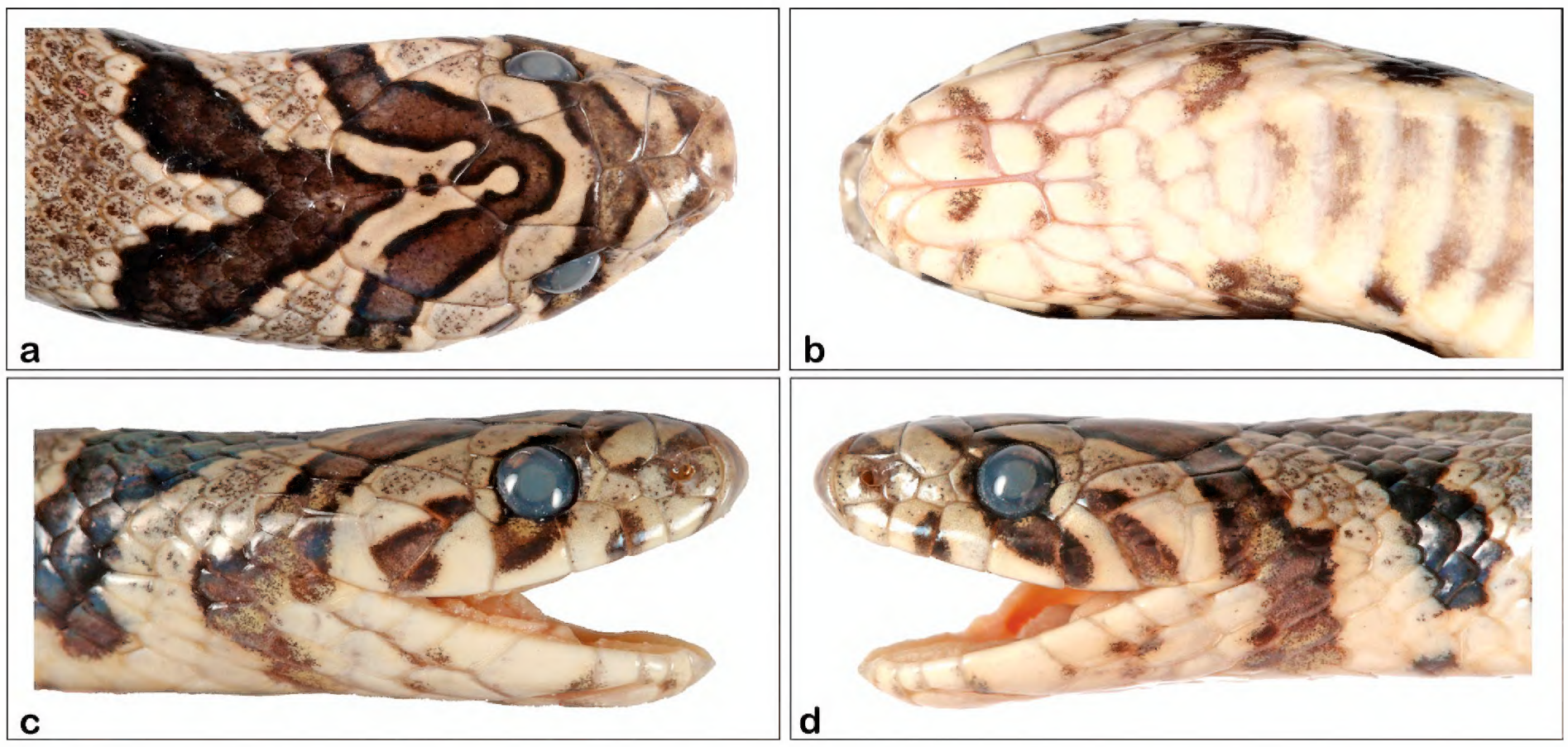

Figure 3. *Oligodon churahensis* sp. nov. holotype female NCBS NRC-AA-019, view of the head, (**a**) dorsal, (**b**) ventral, (**c**) lateral right, (**d**) lateral left.

pentagonal, longer (1 mm) than high (0.6 mm). Two postoculars, subequal. Eye circular, 1.9 mm diameter of the eye with a circular pupil. Seven supralabials, third and fourth in contact with eye (Fig. 3c, d). Supralabial increase in size gradually, fifth and seventh larger than the rest. Second supralabial in contact with posterior nasal, loreal and first + third supralabials. Sixth supralabial deeply embedded between fifth and seventh supralabial, remotely making contact with the upper jawline on the right lateral side of the head (Fig. 3c). The sixth supralabial makes broad contact with the jawline on the left side of the head (Fig. 3d).

Mental short, triangular, wider (1.9) than long (1.2). Infralabials 7, first really long, II to VI infralabials short and thin, fifth onwards larger (Fig. 3b). First four infralabials in contact with the genials. Anterior genials almost one and a half times as long (2.5 mm) as wide (1.7 mm); posterior genials as long as wide (1.2 mm) (Fig. 3b). The right genials are fused.

Body rounded, compressed, ventral surface distinctly flattened. Dorsal scales in 17-17-15 rows. First lateral reduction observed after the 10th ventral is at 50% of the ventrals where third and fourth DSR are involved in reduction from 17 DSR to 16 at ventral 85, thereafter from 16 DSR to 15 at the 90th ventral, row 2 +3 involved (52.9%). Dorsal scales imbricate, regularly arranged, vertebral scales not enlarged. All body scales smooth and glossy, without apical pit. Ventral scales 175 in number excluding two

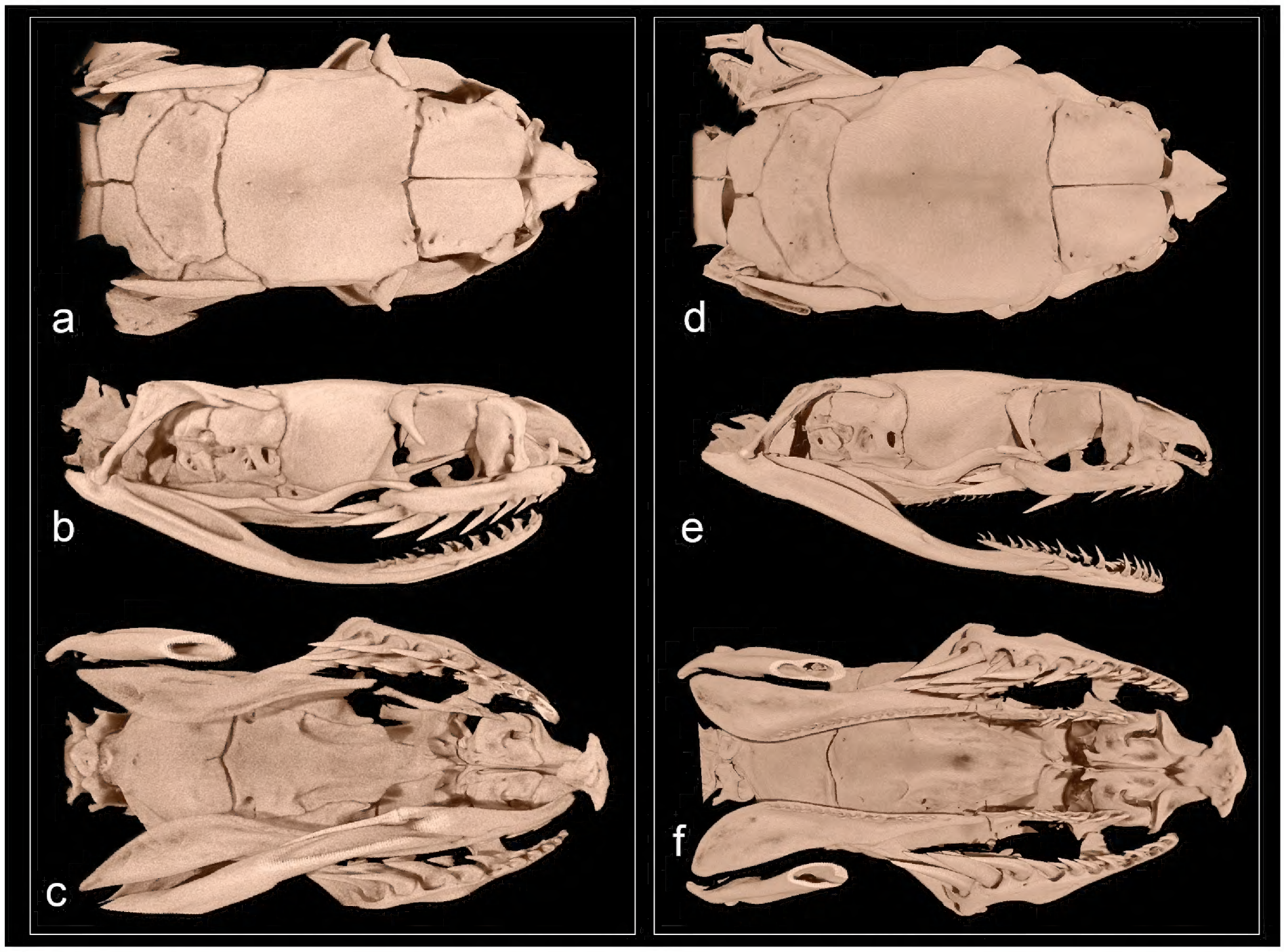

Figure 4. Micro CT scan images of the skull, (**a–c**) *Oligodon churahensis* sp. nov. holotype female NCBS NRC-AA-019; (**d–f**) *Oligodon arnensis* NCBS NRC-AA-020 showing dorsal view (**a, d**), lateral view (**b, e**) and ventral view (**c, f**).

preventrals. Anal shield divided, slightly larger than last ventral scale. Subcaudals paired, 46 in number. Tail terminates in a sharp, tapering apical spine. Total length 335 mm, tail length 60 mm, tail/total length ratio 0.18.

Colouration. 'In preservative' Overall in a shade of pale brown with broad dark brown to black bands throughout the body. Each dorsal scale bears dark brown mottling. The first band is thin that runs across the internasals, the second in shape of a chevron that runs from fourth supralabial along the eye on the either side of the head and joins at the prefrontals. The third one, runs from the posterior of the angle of the jaw along the posterior temporals and further along the parietal and meets the frontal. The fourth broad chevron mark (4–5 scales wide) meets at the posterior portion of the parietal. The dorsal broad black bands are 1–2 scale wide edged with cream colour. The bands in the anterior 1/3rd of the SVL are not connected at the vertebral scale row. Each dorsal band is spaced by 3–4 dorsal scales. Forty-five bands on the dorsum from the nape to the vent and nine bands on the tail. Ventral scales white with brown smear along the width of each scale, the smear is darker on the lateral edges forming a blotch on each side.

Skull features: A complete and robust skull typical of members of the family Colubridae (Cundall and Irish 2008). Maxilla with 8–10 functional teeth, gradually increasing in size posteriorly (Fig. 4b). The palatine bone is slender, lacking teeth so is the pterygoid (Fig. 4c). Postorbital bone slender, conical, directed downwards, not making contact with the maxillary bone.

Hemipenial morphology of paratype male BNHS 3657 (everted organs, N=2): The hemipenis is fully everted and expanded. The organ is stout, slightly bilobed, and semicapitate; lobes extend to about 20% of the hemipenis. The organ is spinous throughout; the spines are larger near the base and mid body and gradually decreases in size distally; sulcus spermaticus deep, bifurcating on the terminal fifth of the hemipenial body, with centrolineal orientation; the spine line on either side of the sulcus spermaticus is weak; hemipenial base is nude, with few spinnules.

Natural history notes. The holotype and the paratype were found actively moving along a mud road around 20:00 hours (Fig. 6b). Additionally, five more individuals (uncollected) of the species were encountered at the same locality between the last weeks of May to late June 2020. All the individuals were found near the village after dusk. Sympatric reptile species recorded at the locality include *Cyrtodactylus chamba* Agarwal, Khandekar & Bauer, 2018, *Asymblepharus* sp., *Lycodon mackinnoni* Wall, 1906, *Gloydius himalayanus* (Günther, 1864), *Orthrio-*

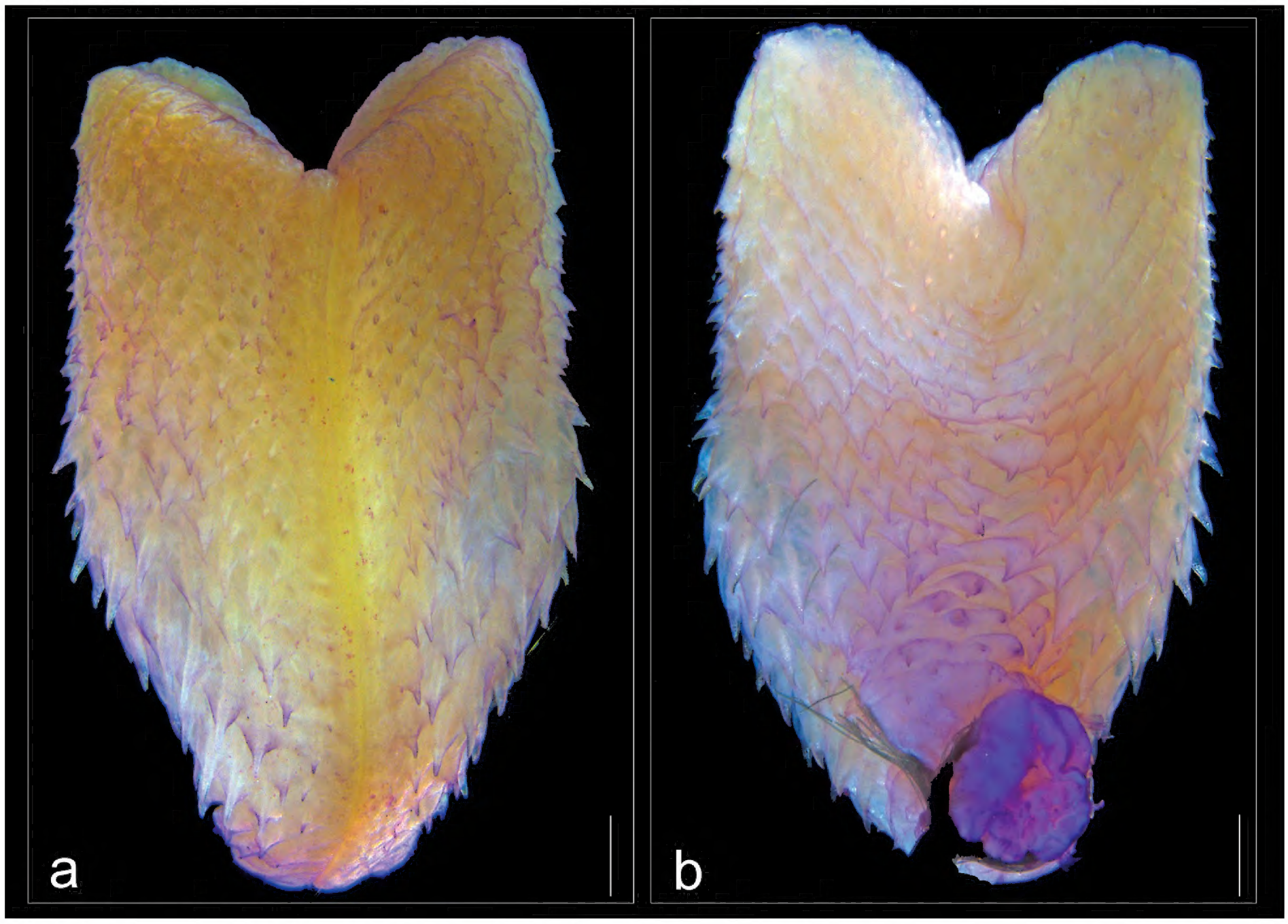

Figure 5. Hemipenis of *Oligodon churahensis* sp. nov. paratype male BNHS 3657 (**a**) sulcal view, (**b**) asulcal view. Scale bars: 1 mm.

Figure 6. *Oligodon churahensis* sp. nov. holotype female NCBS NRC-AA-019 in life (**a**); a general view of the habitat at the type locality (**b**), Photos by Virender Kumar.

phis hodgsonii (Günther, 1864), *Laudakia* sp. and *Liopeltis* sp. None of the observed individuals showed any sign of aggression nor did they try to bite except for the male paratype, which bit one of us upon capture.

Variation. The paratype male agrees with the description of the female holotype except for differences listed here: V 170 (+2 preventrals) Sc 47, first 8 subcaudals undivided thereafter the 9th subcaudal is divided followed by three undivided subcaudals and the rest are divided (13th onwards). The colouration of the male is much darker in comparison with the holotype. The number of dark bands on the dorsum in the paratype male is 37 bands from nape to the vent and 11 on the tail. Variation in the scale reduction formula is presented in Table 1 (Suppl. material 3).

Table 1. Scale reduction formula for the type specimens, (a) holotype female NCBS NRC-AA-019 (b) paratype male BNHS 3657.

(a)	$17(10)\frac{2+3(90)}{3+4(85)}15(170)$
(b)	$17(10)\frac{3+4(88)}{3+4(87)}15(175)$

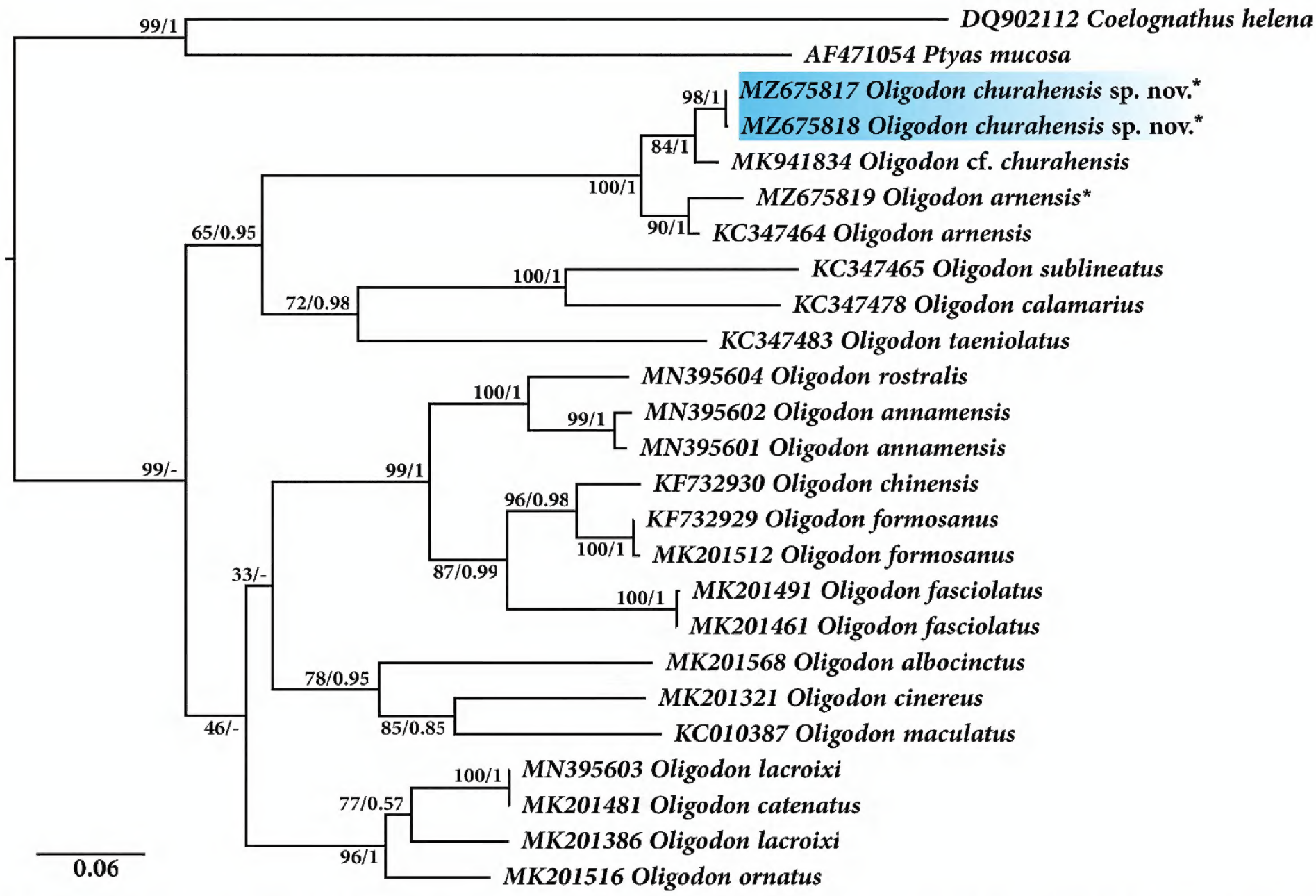

Figure 7. Maximum Likelihood phylogeny of selected species of the genus *Oligodon* showing relationships based on partial fragment of mitochondrial cytochrome b gene. Tree generated through bootstrap replicates of 1000 through an ultrafast tree search option. Numbers at nodes represent ML bootstrap support values. Species bearing '*' were generated in the present study.

Discussion

Phylogenetic analysis based on mitochondrial cytochrome b gene recovered two well-supported clades within *Oligodon*, *viz* the *'arnensis'* clade and the '*albocinctus*' clade. The new species, *O. churahensis* sp. nov. was found to be a member of the *'arnensis'* clade, and the clade containing it is sister to *O. arnensis* (Fig. 7). The new species is sister to a lineage from Pakistan, which is here referred as *Oligodon* cf. *churahensis*. The new species differs from congeners in showing a pairwise sequence divergence of 6–20% and 15% for *O. arnensis* from Maharashtra and 19% for *O. arnensis* from Sri Lanka (Table 2). The phylogenetic relationships recovered in the present work should be treated as preliminary as it is based on a single gene and only a few species of the genus.

Species of the genus *Oligodon* are known to feed on reptile and bird eggs (Wall 1921; Daniel 2002; Whitaker and Captain 2004). The new species lacks teeth on the palatine and pterygoid, also known from some species of the genus (Boulenger 1890, Wall 1921, Smith 1943). This could be an adaptation for a shift in the diet that largely comprises of reptile and or bird eggs. Modification of teeth in snakes is driven by its diet (Hoso et al. 2007; Rajabizadeh et al. 2021) and vestigial or loss of teeth is seen in snakes that feed on eggs (Gans and Oshima 1952; Gans and Williams 1954; Vitt and Caldwell 2013). Dietary investigations of the species would be necessary to confirm the preceding hypothesis.

Molecular divergence observed for representatives of *O. arnensis* from Maharashtra and Sri Lanka is 3% for mitochondrial cytochrome b gene (Table 2) hinting on presence of cryptic diversity. Furthermore, the population from Maharashtra bears a loreal shield and the dorsal bands are broad unlike the population from southern India and Sri Lanka (NHM 1946.1.4.36 = type of *Simotes albiventer*) that lack the loreal shield and bear thin dorsal bands. Based on the iconotype (plate XXXVIII, Fig. 1b) of Russell (1796), the population from southern India (plate XXXV of Russell (1796) Fig. 1a), lacking

Table 2. Un-corrected pairwise sequence divergence for *Oligodon* spp. for the mitochondrial cytochrome b gene.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	DQ902112 *Coelognathus helena*																								
2	AF471054 *Ptyas mucosa*	0.19																							
3	MZ675817 *Oligodon churahensis* sp. nov.	0.20	0.19																						
4	MZ675818 *O. churahensis* sp. nov.	0.20	0.19	0.00																					
5	MZ675819 *O. arnensis* Maharashtra	0.20	0.20	0.06	0.06																				
6	KC347464 *O. arnensis*	0.20	0.20	0.05	0.05	0.03																			
7	MK941834 *O.* cf. *churahensis*	0.19	0.19	0.03	0.03	0.06	0.05																		
8	MN395604 *O. rostralis*	0.20	0.19	0.17	0.17	0.16	0.16	0.17																	
9	MN395603 *O. lacroixi*	0.19	0.19	0.15	0.15	0.15	0.15	0.15	0.13																
10	MN395602 *O. annamensis*	0.20	0.18	0.16	0.16	0.16	0.16	0.16	0.07	0.14															
11	MN395601 *O. annamensis*	0.19	0.18	0.16	0.16	0.16	0.16	0.16	0.07	0.13	0.01														
12	KF732930 *O. chinensis*	0.20	0.18	0.16	0.16	0.15	0.16	0.15	0.11	0.13	0.11	0.10													
13	KF732929 *O. formosanus*	0.20	0.18	0.15	0.16	0.16	0.16	0.15	0.11	0.14	0.11	0.11	0.05												
14	MK201516 *O. ornatus*	0.20	0.19	0.15	0.15	0.15	0.15	0.14	0.14	0.08	0.12	0.12	0.11	0.12											
15	MK201512 *O. formosanus*	0.20	0.18	0.16	0.16	0.16	0.16	0.16	0.11	0.11	0.10	0.10	0.04	0.00	0.12										
16	MK201491 *O. fasciolatus*	0.20	0.17	0.16	0.16	0.17	0.17	0.17	0.12	0.13	0.12	0.11	0.09	0.09	0.14	0.09									
17	MK201461 *O. fasciolatus*	0.20	0.17	0.16	0.16	0.17	0.17	0.17	0.12	0.13	0.11	0.11	0.09	0.08	0.14	0.09	0.00								
18	MK201386 *O. lacroixi*	0.19	0.19	0.14	0.14	0.14	0.14	0.16	0.13	0.07	0.11	0.11	0.11	0.11	0.08	0.11	0.14	0.13							
19	MK201568 *O. albocinctus*	0.21	0.17	0.16	0.16	0.17	0.18	0.18	0.15	0.15	0.16	0.16	0.16	0.16	0.14	0.16	0.15	0.15	0.15						
20	MK201481 *O. catenatus*	0.19	0.19	0.15	0.15	0.15	0.15	0.16	0.13	0.00	0.12	0.12	0.11	0.11	0.08	0.11	0.13	0.13	0.07	0.15					
21	MK201321 *O. cinereus*	0.19	0.18	0.13	0.13	0.13	0.14	0.14	0.14	0.13	0.13	0.12	0.12	0.12	0.14	0.12	0.14	0.13	0.13	0.13	0.13				
22	KC010387 *O. maculatus*	0.21	0.21	0.16	0.16	0.16	0.16	0.18	0.16	0.15	0.15	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.13	0.13	0.14	0.12			
23	KC347465 *O. sublineatus*	0.20	0.19	0.18	0.18	0.17	0.18	0.18	0.18	0.15	0.17	0.17	0.17	0.17	0.18	0.17	0.18	0.18	0.17	0.16	0.15	0.16	0.18		
24	KC347478 *O. calamarius*	0.20	0.21	0.17	0.17	0.17	0.17	0.18	0.19	0.16	0.17	0.18	0.18	0.18	0.16	0.17	0.17	0.16	0.15	0.17	0.14	0.16	0.17	0.13	
25	KC347483 *O. taeniolatus*	0.19	0.18	0.15	0.15	0.16	0.15	0.17	0.15	0.15	0.16	0.16	0.16	0.17	0.16	0.17	0.17	0.16	0.14	0.19	0.14	0.16	0.18	0.17	0.16

Table 3. Comparison of the new species with *Oligodon* species bearing 17 DSR from south Asia. Missing data denoted by N.A.

Species	Source	Ventrals	Subcaudals	Anal	Supra-labials	Loreal	Hemipenis	Maxillary teeth	Palatine, Ptyregoid teeth	Dorsal Pattern	Ventral Pattern
Oligodon churahensi sp. nov.	present study	170–175	46–47	divided	7	present	forked, spinose	8–10	absent	48–54 bands on body	whitish with brown smear
O. affinis	Smith 1943; Whitaker and Captain 2004	128–133	23–36	divided	7	absent	not forked, spinose	7	N.A.	31–41 bands on body	whitish with rectangular black marking
O. arnensis	Smith 1943; present study	161–202	41–59	divided	6–8	absent	forked, spinose	8–11	present	≤40 bands on body	white without any marking
O. cinereus	Smith 1943	157–185	29–42	single	8	present	not forked, lack spines	10–12	N.A.	variable	variable
O. erythrogaster	Smith 1943	169–186	42–59	divided	7	absent	not forked, lack spines	7–8	N.A.	stripes	reddish with black spots on the edges
O. melanozonatus	Smith 1943	171–173	42–45	divided	6	absent	N.A.	8	N.A.	bands	whitish with squarish black spots
O. theobaldi	Smith 1943	164–180	30–42	divided	8	present	not forked, lack spines	15–16	N.A.	4 stripes with faint transverse bands	variable
O. travancoricus	Smith 1943; Ganesh et al. 2009	150–155	31–39	divided	7	absent	not forked, spinose	7	N.A.	23–27 bands on body	white with black checkered marking
O. venustus	Smith 1943	138–165	27–36	divided	7	absent	not forked, spinose	7–8	N.A.	bands made up of rhomboid or oval spots	whitish with black quadrilateral spots
O. woodmasoni	Smith 1943; Vijayakumar and David 2006	164–190	43–57	single	6	present/ absent	not forked, lack spines	8–10	N.A.	8 longitudinal stripes	whitish with a brown stripe in the centre and a dark spot on the edges

the loreal shield should be treated as *Oligodon arnensis sensu stricto*. The status of the putative synonyms is currently under investigation concerning their validity (Bandara et al. in press).

The Western Himalayas was thought to harbour a subset of the Eastern Himalayan biodiversity (Mani 1974; Srinivasan et al. 2014). However, discovery of several distinct lineages of reptiles, including the present discovery (Agarwal et al. 2014; Mirza et al. 2020a) from the region requires a change in our outlook. We warrant dedicated surveys to document the herpetofaunal diversity of the region that is grossly underestimated.

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Supplementary material 1

Figure S1. Plate 35 of Russel (1796)

Authors: Zeeshan A. Mirza, Virender Kumar Bhardwaj3, Harshil Patel

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Supplementary material 2

Figure S2. Plate 38 of Russel (1796)

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Supplementary material 3

Figure S3. Paratype male of *Oligodon churahensis* sp. nov.

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